

Utility name : pn2vol1

Purpose

pn2vol1 computes the temperature and pressure variation in a pneumatic chamber using a polytropic model.

Description

In order to reduce the model complexity or by lack of data concerning thermal exchange, a simple model using polytropic hypothesis is proposed. We have :

$$P \cdot V^k = \text{constant}$$

where k is the polytropic coefficient

Using the perfect gas law, we have the following relation between pressure and temperature :

$$P^{1-k} \cdot T^k = \text{constant}$$

By differentiating the previous equation, we express the temperature derivative as a function of pressure variation :

$$\frac{dT}{dt} = \frac{k-1}{k} \frac{T}{P} \frac{dP}{dt}$$

If we differentiate the ideal gas relation, $(P.V = m.r.T)$, we can calculate the pressure derivative as :

$$\frac{dP}{dt} = P.k \cdot \left(\frac{1}{m} \frac{dm}{dt} - \frac{1}{V} \frac{dV}{dt} \right)$$

Fortran 77 call prototype

```
external pn2voll
double precision dtemp, dpress, temp, press, sdm, mgas
double precision dvolt, volt, k
integer gi
call pn2voll(dtemp, dpress, temp, press, sdm, mgas, dvolt, volt, k, gi)
```

C call prototype

```
extern void pn2voll_
(
#ifdef _NO_PROTO
    double *dtemp, double *dpress, double *temp, double *press, double *sdm,
    double *mgas, double *dvolt, double *volt, double *k, int *gi
#endif
)
```

```
)  
pn2voll_(dtemp, dpress, temp, press, sdm, mgas, dvolt, volt, &k, &gi)
```

Arguments

Inputs

- ***dtemp***, temperature into the chamber [K]
- ***dpress***, pressure into the chamber [PaA] (>0)
- ***sdm***, sum of input mass flows [kg/s]
- ***mgas***, mass of gas [kg] (>0)
- ***dvolt***, total derivative volume [m³/s]
- ***volt***, total volume [m³] (>0)
- ***k***, Polytropic constant [null]
- ***gi***, gas type index

Outputs

- ***dtemp***, temperature derivative [K/s]
- ***dpress***, pressure derivative [PaA/s]